078841 on Jul. 27, 2006. Also incorporated by reference are U.S. Provisional Patent Application Ser. No. 60/959,358, filed Jul. 13, 2007, entitled "Droplet-Based Selection," by Weitz, et al., U.S. Provisional Patent Application Ser. No. 61/048,304, filed Apr. 28, 2008, entitled "Microfluidic Storage and Arrangement of Drops," by Schmitz, et al.; and International Patent Application No. PCT/US2007/017617, filed Aug. 7, 2007, entitled "Fluorocarbon Emulsion Stabilizing Surfactants," by Weitz, et al.

[0038] One aspect of the invention relates to systems and methods for producing droplets of fluid surrounded by a liquid. These fluids can be selected among essentially any fluids by those of ordinary skill in the art by considering the relationship between the fluids. The fluidic droplets may also contain other species in some cases, for example, certain molecular species (e.g., monomers, polymers, metals, etc.), cells, signaling entities, particles, other fluids, or the like. In some cases, the fluid and the liquid may be selected to be immiscible within the time frame of the formation of the fluidic droplets. The fluid and the liquid may be essentially immiscible, i.e., immiscible on a time scale of interest (e.g., the time it takes a fluidic droplet to be transported through a particular system or device). In certain cases, the droplets may each be substantially the same shape and/or size.

[0039] As used herein, the term "fluid" generally refers to a substance that tends to flow and to conform to the outline of its container, i.e., a liquid, a gas, a viscoelastic fluid, etc. Typically, fluids are materials that are unable to withstand a static shear stress, and when a shear stress is applied, the fluid experiences a continuing and permanent distortion. The fluid may have any suitable viscosity that permits flow. If two or more fluids are present, each fluid may be independently selected among essentially any fluids (liquids, gases, and the like) by those of ordinary skill in the art, e.g., by considering the relationship between the fluids. The fluids may each be, for example, miscible, slightly miscible, or immiscible. Where the portions remain liquid for a significant period of time, then the fluids may be chosen to be at least substantially immiscible. Those of ordinary skill in the art can select suitable miscible or immiscible fluids, using contact angle measurements or the like, to carry out the techniques of the invention. As used herein, two fluids are immiscible, or not miscible, with each other when one is not soluble in the other to a level of at least 10% by weight at the temperature and under the conditions at which the emulsion is used. For instance, the fluid and the liquid may be selected to be immiscible within the time frame of the formation of the fluidic droplets.

[0040] A "fluidic droplet" or a "droplet," as used herein, is an isolated portion of a first fluid that is completely surrounded by a second fluid. It is to be noted that a fluidic droplet is not necessarily spherical, but may assume other shapes as well, for example, depending on the external environment, the dimensions of the channel or other container that the fluidic droplet is contained within, etc. Examples of a fluidic droplet contained within a liquid include, but are not limited to, a hydrophilic liquid suspended in a hydrophobic liquid, a hydrophobic liquid suspended in a hydrophilic liquid, a gas bubble suspended in a liquid, etc. Typically, a hydrophobic liquid and a hydrophilic liquid are essentially immiscible with respect to each other, where the hydrophilic liquid has a relatively greater affinity to water than does the hydrophobic liquid. Examples of hydrophilic liquids include, but are not limited to, water and other aqueous solutions comprising water, such as cell or biological media, salt solutions, etc., as well as other hydrophilic liquids such as ethanol. Examples of hydrophobic liquids include, but are not limited to, oils such as hydrocarbons, silicone oils, mineral oils, fluorocarbon oils, organic solvents, etc.

[0041] In some embodiments, the invention generally relates to an emulsion. The emulsion may include droplets, such as those described above, and/or colloid particles, for example, nanoparticles such as those described below. As used herein, an "emulsion" is given its ordinary meaning as used in the art, e.g., a liquid dispersion. In some cases, the emulsion may be a "microemulsion" or a "nanoemulsion," i.e., an emulsion having a dispersant on the order of micrometers or nanometers, respectively. As one example, such an emulsion may be created by allowing fluidic droplets of the appropriate size or sizes (e.g., created as described herein) to enter into a solution that is immiscible with the fluidic droplets.

[0042] In certain cases, a fluidic stream and/or the fluidic droplets may be produced on the microscale, for example, in a microchannel. Thus, in some, but not all embodiments, at least some of the components of the systems and methods are described herein using terms such as "microfluidic" or "microscale." As used herein, "microfluidic," "microscopic," "microscale," the "micro-" prefix (for example, as in "microchannel"), and the like generally refers to elements or articles having widths or diameters of less than about 1 mm, and less than about 100 micrometers in some cases. In some cases, the element or article includes a channel through which a fluid can flow. In all embodiments, specified widths can be a smallest width (i.e., a width as specified where, at that location, the article can have a larger width in a different dimension), or a largest width (i.e., where, at that location, the article has a width that is no wider than as specified, but can have a length that is greater). Thus, for example, a fluidic stream may be produced on the microscale, e.g., using a microfluidic channel. For instance, the fluidic stream may have an average cross-sectional dimension of less than about 1 mm, less than about 500 microns, less than about 300 microns, or less than about 100 microns. In some cases, the fluidic stream may have an average diameter of less than about 60 microns, less than about 50 microns, less than about 40 microns, less than about 30 microns, less than about 25 microns, less than about 10 microns, less than about 5 microns, less than about 3 microns, or less than about 1 micron.

[0043] A "channel," as used herein, means a feature on or in an article (e.g., a substrate) that at least partially directs the flow of a fluid. In some cases, the channel may be formed, at least in part, by a single component, e.g., an etched substrate or molded unit. The channel can have any cross-sectional shape, for example, circular, oval, triangular, irregular, square or rectangular (having any aspect ratio), or the like, and can be covered or uncovered (i.e., open to the external environment surrounding the channel). In embodiments where the channel is completely covered, at least one portion of the channel can have a cross-section that is completely enclosed, and/or the entire channel may be completely enclosed along its entire length with the exception of its inlet and outlet.

[0044] A channel may have an aspect ratio (length to average cross-sectional dimension) of at least 2:1, more typically at least 3:1, 5:1, 10:1, 30:1, 100:1, 300:1, 1000:1, etc. As used herein, a "cross-sectional dimension," in reference to a fluidic or microfluidic channel, is measured in a direction generally perpendicular to fluid flow within the channel. An open chan-